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DRAFT

[redacted]

UBJECT: Orbital/Terrestrial Study

1. In order to determine what instrumentation is necessary the following personnel should be contacted:

25X1A [redacted]

25X1A

2. Areas of particular interest would be obtained from TID, PID, and PAG.

3. Correlation of all of the above areas will be made and from data available the following would be initiated:

25X1A a. Microdensitometer edge traces by [redacted] Westover

25X1A AFB or TID of NPIC [redacted]

b. Refinement or revision of [redacted] E. V. curves. 25X1A

4. From accumulation of the above data the following is expected:

a. A change to or verification of ramps (V/H settings) used to obtain photography for the various systems.

b. Statistical data which will allow revision of the E. V. curves for photography other than the present high altitude photography.

c. Accumulation of data indicating the correlation of the system's transfer function in respect to resolution targets and measured ground imagery.

d. A useful key which would help in the photointerpretation procedures when physical dimensions are measured on film under varying environmental conditions.

18 May 1964

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Latest edition almost

Orbital-Terrestrial Photo. Eval Study

Edited by [redacted]

by 12 Mar 64

RESEARCH OBJECTIVES [redacted]

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I. Introduction

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It is the purpose of this study to provide answers to resolution, acuity and ground truth problems which cannot be fully resolved from a laboratory procedure. During the progress of the various systems development, it has been the standard procedure to test the camera under controlled laboratory conditions. This provided statistics for determining the characteristics of the camera for known environmental conditions; however, extensive operational correlation of environmental and ground parameters has not been made. It is proposed that a ~~comparison~~ program be ~~made~~ initiated for determining the operational capabilities of the camera systems by evaluating photography and relating this with respect to specific data gathered from gound stations at the instant of photographic exposure. This program will incorporate ground stations, high altitude and orbital correlation for photographic evaluation of a number of missions. Essentially, the KH-4 system will be used ~~since~~ with the 112-A ~~program will~~ providing configuration provide high altitude photography ~~with~~ the same camera type as used in the orbital system. In photographing ground targets

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[redacted] with both of these systems, data will be collected to determine the effect of ambient, high altitude and orbital environmental conditions on the camera systems. This program would ~~then~~ provide criteria by which photographic quality for varying operational conditions could be predicted with great accuracy. It would also provide data for determining film/camera capabilities, exposure requirements and processing procedures.

2. CONCEPT

2.1. Purpose. Primarily, this program will provide data for determining the capability of the camera system under operational conditions. In addition,

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RESEARCH OBJECTIVES

I. Introduction

A study is proposed to evaluate the present operational capability of the KH-4 System by relating its photography to specific ground data gathered at ground stations at time of exposure. The program would be based on a number of high-altitude missions with the C[III] Camera used with the 112-A configuration (same camera type as in the orbital system). These missions would be flown in conjunction with programmed orbital missions and planned.

Problems in resolution, acuity and ground truth cannot be fully solved through laboratory testing. During the progress of the various systems development, it has been standard procedure to test cameras under controlled laboratory conditions. This provided statistics on a camera's characteristics in known environments; however, extensive correlation of operational factors -- actual environmental and ground parameters -- has not been made. In the proposed program, by photographing ground targets in domestic areas with both KH-4 and 112A systems, data will be collected and correlated on the effect of ambient, high altitude and orbital environmental conditions on the systems.

II. Purpose

2.1. PURPOSE. Data collected on such aspects* would provide criteria for accurately predicting image quality of both camera systems under varying environmental conditions. It will be possible to compare the modulation transfer function of the orbital system with that of essentially the same type of photography taken through 90% of the earth's atmosphere.

* as minimum acceptable sun angle, film types, camera setting & optimum processing procedures

an analysis of this data will enable the prediction of image quality under varying ambient and atmospheric conditions, for both 112-A & orbital systems.

2.2. Scope. This program will ~~have to~~ be divided into two phases, operational and support.

2.2.1. ~~The~~ operational phase will include the following:

25X1A 2.2.1.1. Orbital photography ~~obtained~~ over [redacted] areas with the KH-4 camera system.

2.2.1.2. ~~U-2~~ Aircraft flights using the 112-A configuration to obtain photography of the same areas through [redacted] (WHICH WOULD BE 90%) of the earth's atmosphere.

2.2.1.3. Ambient data determined ~~from~~ by instrumentation at ground stations IN THE FLIGHT PATH, photographed by the orbital and ~~U-2~~ aircraft flights.

2.2.2. ~~The~~ support Procedures: ~~phase will incoprorate the following procedures:~~

25X1A 2.2.2.1. Evaluation of all [redacted] photography taken of the ground stations by a group of photointerpreters.

2.2.2.2. Correlation of ground station data with the evaluations of the photography.

2.2.2.3. Analyses of the program ~~resulting in the establishment of~~ to establish the criteria for assessment of these and smilar missions.

2.2.3. It is anticipated that sufficient information cannot be obtained ~~xxx~~ from one concurrent attempt to obtain all of this data. THEREFORE, THE This program should be carried on until sufficient trends are established and accurate prediction of the results of subsequent missions are made and are proven valid.

3. REQUIREMENTS no increase

3.1. Orbital Photography. The programmed exposure of film ~~xxxx~~ over

25X1A [redacted] test areas shall be made in the normal course of the KH-4 mission.

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To accomplish this, it ~~is~~ would be necessary ~~that~~ to know the time and exact geographic location of the vehicle ~~be known~~. These factors will enable the planning of underflights ~~at~~ for the same time, over the some area ~~concerned~~.

3.1.1. ~~Use of~~ Eastman Kodak film 4404 (SO 132) should be used in this mission ~~provide a basis~~ for comparison with the film from most of the previous KH-4 missions.

3.1.2. Camera calibrations and other statistics (such as slit width, ramp setting, etc.) shall be recorded as a part of the related data.

3.1.3. Orbital parameters such as temperatures, geographic location, altitude and attitude should will also be provided.

3.1.4. The ~~requirements as indicated will~~ necessitate correlation of the "Camera Calibration Log" and other ephemeral data with any additional information that can be obtained from the [redacted] Company in regard to film processing and film-handling. 25X1A

3.2. High-Altitude Photography. ~~Use of~~ a U-2 vehicle with a 112-A camera configuration is required for the purpose of correlating systems capability.

3.2.1. Eastman Kodak film 4404 (SO 132) shall also be used ~~to correspond to that used~~ in the orbital vehicle.

3.2.2. Camera calibration and other statistics (such as slit width and scan rate) shall be included in the report.

3.2.3. A flight log shall be kept ~~giving~~ on temperature, weather conditions, ground velocity, attitude, course and "Z" time ~~and~~ all ~~any~~ deviations should will be properly appropriately recorded.

3.2.4. Altitude of the photography will be recorded at the ~~beginning~~ start and termination of photographic pass and will be taken from 65,000 feet MSL.

3.2.5. The direction of flight and flight path will approximate that of the orbital vehicle.

3.2.6. ~~All information required~~ Collateral information (in the form of flight logs, camera data logs and processing data reports) should be available made ~~in the form of~~

3.3. Ground Stations. These would include suitable appropriate areas along the

flight path of the orbital vehicle which are accessable for set-up of appropriate instrumentation and from which surveys of objects of interest can be surveyed.

3.3.1. Ambient data will be collected one hour prior to, during, and one hour after the scheduled operational photographic missions. This data will include, but will not necessarily be limited to, the following:

a. Spectral Reflectance

b. Sun Angle

(1). "Z" time

(2). Date

(3) Geographic Location

c. Gray Scale Equivalent of Targets

d. Light Intensity

e. Altitude

f. Barometric Pressure

G. Temperature

h. Humidity

i. Atmospheric Conditions (Haze, smoke, % cloud cover, cloud type and wind velocity).

j. Dimensions (object sizes and shapes).

3.3.2. Densely populated areas provide a great variety of more sizes and shapes,

25X1A

[redacted]

Other measurements taken from roads, sidewalks, vehicles or other appropriate objects can be made at any convenient time and incorporated into the report. Military installations could very easily be used in this study.

3.3.3. Sparsely populated and open areas can be used to determine low-contrast functions of the camera systems and CAN ALSO BE USED for in addition to examination of images of [redacted] such as homes, vehicles, fence intersections, streams and the like.

3.3.4. Areas to be designated for these surveys will be determined at the earliest possible time moment so that correlation of controlled conditions can be made with the orbital photography. Photography taken on the ground of buildings, roads, etc., will be used to supplement target identification wherever possible.

25X1A [redacted]

ground test areas such as densely populated, sparsely populated and open areas, it may be more desirable to solicit determine the availability ~~of~~ Air Force or other service ~~for this~~ support. The number of instruments and ~~the~~ number of personnel necessary, may also impose limitations on the THE GENERAL EXTENT OF THE PROJECT availability of commercial companies INTERESTED ~~that would indicate an interest in a project as extensive as this.~~

25X1A 3.3.6. [redacted] all field data, accumulated as ~~an~~ part of ~~effort~~ under this project, will become government property and ~~will~~ SHALL not be reproduced without ~~the~~ consent of the project monitor.

3.4. Photointerpretation. A subjective evaluation of orbital and high-altitude photography will be made by ~~an~~ effort cleared Air Force, Army and NPIC personnel.

3.4.1. Ground target areas ~~will be indicated~~ must be specifically identified. to be on all photography ~~for~~ subjective evaluation by the photointerpretation teams. evaluated

3.4.2. Measurements will be made for images on the film of and compared ~~to~~ with the actual measurements obtained from the same objects in the field. Physical dimensions of Two measurements should be made; one by the photointerpretation teams with available equipment, and the other using 25X1A [redacted] Comparator or similar instrument. Both measurements can MUST be scaled and comparison made to the actual measurements of the objects.

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4. Conclusion

This study will provide data for an evaluation of operational photography with sufficient collateral from high altitude photography and "ground truth" values to determine with great accuracy the present capability of the KH-4 system. In addition, it will be possible to produce valid conclusions concerning the modulation transfer function of this system from orbital photography and compare it to essentially the same type of photography taken through 90% of the earth's atmosphere. As a result of this study it is conceivable that photographic quality can be predicted and that such factors will enable standardization of operational prerequisites for a successful operation. The test procedures outlined in this report need not be restricted to those systems mentioned but could provide a basis for operational tests of a wide variety of camera systems.

As a result of this study, it is conceivable that the quality of the photographs can be predetermined from known parameters, such as pre flight calibrations and [redacted]. If however

SCOPE also considering other systems to which it is applicable

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[redacted]